NIST's Recommendations Following the Federal Building and Fire Investigation of the World Trade Center Disaster

ICC Code Change Proposals - Status as of November 7, 2006

Proposal	Determination of Wind Loads and Wind Tunnel Testing	S16 (IBC) - Wind tunnel testing. Would achieve uniformity in results where the design involved wind tunnel testing either as required by ASCE 7 or where the designer determines that wind tunnel testing is to be used to determine the wind loads. The proposal references a new testing standard that is currently under development. This proposal is intended to address, in part, recommendation 2 of the NIST report. **Disapproved** - Proposal incorrectly references the wind tunnel test standard as an exception to the ASCE 7 wind load requirements. Doing so would allow designers to circumvent applicable wind load requirements by performing a wind tunnel test. The test standard has not been completed.
Proposal	Structural Frame Approach to Fire Resistance Ratings	FS98 (IBC) - Structural frame rating. Would modify the code's language as to which part of the building is to be considered the structural frame for determining fire resistance rating requirements. This will make it more visible to code users and easier to understand. This proposal is intended to address, in part, *recommendation 7* of the NIST report. **Approved as Submitted** - This change deals with concerns that the structural frame needs to be better defined in order for the level of fire protection to be easier to determine. This revision helps reinforce and distinguish the differences between the primary and secondary structural elements.
Proposal	Disproportionate Collapse	S5 (IBC) - Disproportionate collapse. Would increase the robustness of building structural systems to guard against the possibility of collapse, property loss and casualties that are disproportionate to the original damaging event. This proposal is based on the provisions that have been part of the British Codes for a generation. This proposal is intended to address, in part, *recommendation 1* of the NIST report. **Disapproved** - Concerns were raised that the application of the proposed provisions could result in unintended consequences. There were also concerns that the proposal contains arbitrary and unenforceable requirements. Committee recommended more thorough discussion.
Proposal	Survival of a Building Contents Fire Without Collapse	G69 (IBC) - Building burnout survivability. Would require that buildings greater than 420 feet in height be analyzed and designed to survive a building contents fire without collapse. This proposal is intended to address, in part, *recommendation 8* of the NIST report. **Disapproved** - This proposal was intended to better understand the affect of a building contents fire on the structural integrity of a high rise. Concerns stemmed from a partial reference to the ICC Performance Code within the IBC. The committee felt it needed to be a broader reference or not

		referenced at all. There was also concern with how the design fire would be determined and how the assumed fire dynamics would be evaluated by the authority having jurisdiction.
Proposal	Bond Strength Requirements for Spray-Applied Fire Resistive Materials in Tall Buildings	G68 (IBC) - Sprayed fire resistant materials - Bond strength. Would increase the required adhesion properties of spray-applied fireproofing materials. This proposal is intended to address, in part, *recommendation 6* of the NIST report. **Approved as Modified** - Although the technical support data was not provided in the proposal, this proposal is consistent with the NIST recommendations and should provide for more reliable protection to the steel in high-rise buildings. Using the greater bond strengths will increase the probability that the protection will stay in place and will be less likely to become dislodged. Placing the provisions in the high-rise provisions of Chapter 4 instead of within Chapter 7 is logical because the provisions are only applicable to high-rises and will be more visible within that section. The committee agreed with the different bond strength requirements based upon the building's height as taller buildings are more critical and that imposed loads on tall buildings such as vibration loads may affect the long-term performance. Based on testimony provided, the cost impact of this requirement was considered as being relatively small. The higher density products which are currently available will generally meet these requirements.
Proposal	In-Place Durability of Spray-Applied Fire Resistive Materials	FS100 (IBC) - Sprayed fire resistant materials - application. Would add new text to require that spray fireproofing materials must be installed in accordance with the listing requirements for the fireproofing material. This proposal is intended to address, in part, *recommendation 6* of the NIST report. **Approved as Modified** - This proposal provides enforceable language to assure compliance with code requirements. This helps to address the concern that testing of the adhesion properties must be indicative of the actual in-place conditions. Often, the testing is based on unprimed steel but the actual field installation is done to steel with primers, therefore possibly affecting the adhesion. This proposal includes the provisions directly in the code for easy access and identification by the inspector. The testimony did clarify that the size limitations (Section 714.8.3.2 items 1, 2, and 3) do not limit the size of members which may use SFRM, but instead only limits the size of members for which this section is applicable. All other sizes would be required to comply with their listing.
Proposal	Special Inspections Required for Spray-Applied Fire Resistive Materials	S38 (IBC) - Sprayed fire resistant materials - Inspection. Would address the requirements for special inspections of sprayed fireproofing material applied to structural steel members and metal floor and roof decks. This proposal will increase the number of tests required for fireproofing material. This proposal is intended to address, in part, *recommendation 6* of the NIST report. **Withdrawn** by proponent in favor of S39. S39 (IBC) - Sprayed fire resistant materials - Inspection. Would address the inspection parameters for sprayed fireproofing materials after installation and renovation of mechanical, plumbing, electrical and other similar systems. Included is a proposed method to be used by the inspector to

		verify that the amount of spray applied material reflects the tested fire rated design thickness. This proposal is intended to address, in part, *recommendation 6* of the NIST report. **Approved as Modified** - This proposal provides details to allow for verification that the sprayed fire-resistant material is properly installed. Given the actions the committee has previously taken to assure that the materials are appropriately applied (FS100 and G68) and that the conditions during the application are appropriate, the inspection is important to verify installation and to help assure proper performance. The modifications deleted the requirements for acceptance of the inspection measurements being based upon the "standard deviation." Since this is intended as a means of field inspection, this was replaced by the 10% limitation. The intent of both the original and revised text is to provide a 95% confidence level that the installed material exceeds requirements. The committee noted that Section 1704.10.6 of the proposal does refer to the bond strength of 150 pounds. Based on the action taken on code change G68-06/07 a public comment which directs code users to the new Table 403.15 is needed for high-rise buildings which require greater bond strength.
Proposal	Reliability of Fire Suppression Systems in Tall Buildings	F221 (IFC) - Sprinkler riser design. Would increase the reliability of fire suppression systems in buildings that exceed 420 feet in height by requiring looping of sprinkler systems and independent street-level water feeds. This proposal is intended to address, in part, *recommendation 12* of the NIST report. **Disapproved** - Proposal needs correlation with the referenced standard (NFPA 14), which already requires standpipe redundancy. Number of riser valves may increase the probability of accidental or malicious shut-offs.
Proposal	Adequacy of Stair Capacity for Full Evacuation	G71 (IBC) - Additional exit stair. Would require an additional exit star in all high-rise buildings greater than 420 feet in height. Typical fire fighting operations use the same stair as those evacuating the building, which may impact the time to evacuate. The extra stair is intended to enable rapid evacuation of very tall buildings by ensuring that firefighting activities use a separate stair and do not reduce the exit capacity of the stairs used to evacuate the building. This proposal is intended to address, in part, *recommendation 18* of the NIST report. **Disapproved** - The committee felt that a comprehensive review and consequence analysis of the NIST report was not yet complete, therefore this proposal was premature. Modeling should be done to show the extent that an additional stair would improve exiting. The logistics of closing off a stairway for fire department staging during an emergency evacuation must be investigated. The calculation method for exit stairway width was confusing, and did not clearly indicate the width required for the extra stairway. The location of the extra stairway in relation to the other exit stairways was not indicated. In a high rise, firefighters will typically use the elevator to get near the fire floor and then move to the stairway.
Proposal	Photoluminescent Markings in Exit Paths	E84 (IBC) - Exit path markings. Would require that stair treads, landings and handrails in various types of high-rises, depending on the type of occupancy, be marked with photoluminescent lighting. This proposal is intended to address, in part, *recommendation 18* of the NIST report.

		Disapproved - Committee thought the intent had merit but there were other ways and systems that could address the exiting concerns. The committee directed those testifying to work together to resolve the issues and that the resulting proposal should be technology neutral - not just for photo luminescent materials. The markings should delineate the exit path in the exit stair. It was questioned why the proposal was occupancy specific.
Proposal	Remoteness of Exit Stair Enclosures	G72 (IBC) - Exit remoteness. The purpose of this proposal is to require stair shafts to meet more restrictive remoteness criteria - locating the stair shafts as far apart in order to minimize the potential for a single fire event to render both stairs unusable. Stairs would have to be separated one-half of the diagonal distance of the floor if there are two stairways or at least one-third if there are three or more stairways. This proposal is intended to address, in part, *recommendation 18* of the NIST report. **Disapproved** - The committee felt that a comprehensive review and consequence analysis of the NIST report was not yet complete, therefore this proposal was premature. The term 'structural bay' was not defined. The standard 'structural bay' is not used in high rise construction. Justification was not provided for the significant change for the additional separation of exits, especially if the additional stairway in G71 is also required. The 1/2 of the diagonal dimension, in a standard plan with three or more stairways, would force the stairway enclosure to be located outside of the building footprint. An analysis of the architectural and engineering impact of this change must be performed.
Proposal	Structural Integrity Criteria for Stair Enclosures	G73 (IBC) - Exit enclosure integrity. Would establish a standard for the structural integrity of exit stairway enclosures. The standard proposed was a design that is capable of resisting a 2 psi load on the enclosure. This proposal is intended to address, in part, *recommendation 18* of the NIST report. **Disapproved** - Considerable opposition was voiced, questioning the basis for the 2 psi and how that would impact the design of the structure. It was noted that 2 psi translates to a horizontal design pressure of 288 pounds per square foot which is significant. This design criteria raised questions as to the possible restriction on the type of materials which could comply with this requirement.
Proposal	Continuity of Exit Stairs from Highest Story Served to the Level of Exit Discharge	E137 (IBC) - Exit continuity. Would require that exit stairs serving all buildings be vertically aligned throughout the height of the building with no horizontal transfer corridors except at the level of exit discharge (typically the street level). This proposal is intended to address, in part, *recommendation 18* of the NIST report. **Disapproved** - Eliminating the option of horizontal transfer corridors places severe limitations on building design. Horizontal movement may be needed for adequate dispersion of exits in buildings with set-backs. It was questioned as to whether the NIST WTC report mentioned delays at transfer floors.
Proposal	Emergency Command Centers	G7 (IBC) - Communication/monitoring. Would increase the capability of firefighters and other emergency responders to develop a clear picture of conditions throughout the building which will enable them to better manage evacuation, fire suppression and other emergency response activities.

		Part I of the proposal will require that video cameras be provided in exit stairways, elevator lobbies and other key locations. Part II is intended prescribe the mechanism by which the emergency command center should operate. This proposal is intended to address, in part, *recommendations 13, 14 and 15* of the NIST report. **Part I Disapproved** - This proposal, which was intended to provide firefighters with a tool to better assess conditions throughout the building, was disapproved due to concerns related to the amount of information generated by video monitoring and how it would be managed within a large building. **Part II Disapproved** - While the proposal had merit, items of concern included: use of the term fire chief as defined; the term "temperature sensors" is unclear; some may view the requirements as onerous; needs a clearly defined scope; and video cameras in buildings with high security needs may be problematic.
Proposal	Storage and Distribution of Fuels in Buildings	F220 - Fuel oil storage. Would establish controls on the storage and distribution of fuel oil in high rise buildings that is used to support the emergency power system for the building. The amount necessary to support such equipment often exceeds the allowable quantity permitted by the code. As noted by the proponent of this change, the NIST report did not specifically address this issue, however, the proponent further notes that the Class III combustible liquid distribution system was implicated in the WTC 7 collapse. **Disapproved** - The intent of the proposal is to not classify inside generator fuel oil storage areas in Group H, however it is unclear what effects that would have on public safety. The reference to NFPA 31 is incorrect. It is also unclear as to why the proposal is limited only to high-rise buildings.
Proposal	Elimination of Overhead Obstructions in Exit Paths	F135 (IFC) - Exit path markings. Would require that obstructions within exit paths of existing buildings be outlined with striped markings. This proposal is intended to address, in part, *recommendation 18* of the NIST report. **Disapproved** - No justification for the proposed height or dimensions of the stripes. Concerns also were raised about the visibility of the markings.
Proposal	Fire Service Elevator Requirements (IBC Sections 403.10 and 3007)	G63 (IBC) - Fire service elevator. Would require a minimum of one fire service elevator in buildings 120 feet or higher. The proposal will provide a reasonable degree of safety for firefighters operating the fire service access elevator to a location for staging firefighters and equipment one or two floors below the fire. This proposal is intended to address, in part, *recommendation 21* of the NIST report. **Disapproved**: **Assembly action: As Submitted** - In general, the committee was in favor of the proposal but disapproved the code change based on a variety of issues that need to be addressed: Concern with terminology which currently references a "building stair" instead of an "exit enclosure." Other concerns related to the standard reference to NEMA SB30 and the size of the elevator lobby. The ICC process allows for those in the assembly to voice their views on the committee's action in

		the form of an assembly action where the ICC members vote on the code change. Consideration of this code change included a motion for assembly action for "As Submitted" that was successful. A successful assembly action results in an automatic public comment and therefore this item is automatically placed on the ICC Final Action Agenda.
Proposal	Fire Service Elevator Requirements (IBC Sections 403.9 and 2702) - Illustration of Exit Stair Separation and Fire-Fighting Shafts	